WASTE STREAM 7A114 Decommissioning LLW - Enriched Uranium

SITE	AWE Aldermaston
SITE OWNER	Ministry of Defence
WASTE CUSTODIAN	AWE plc
WASTE TYPE	LLW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m^3
Future arisings -	1.4.2022 - 31.3.2026.....	0 m^3
	1.4.2027 - 31.3.2028.....	66.0 m^3
	1.4.2029 - 31.3.2030.....	613.0 m^3
	1.4.2031 - 31.3.2033.....	749.0 m^3
	1.4.2034 - 31.3.2036.....	749.0 m^3
	1.4.2037 - 31.3.2039.....	1133.0 m^3
	1.4.2040 - 31.3.2042.....	721.0 m^3
	1.4.2043 - 31.3.2070.....	0 m^3
	1.4.2071 - 31.3.2073.....	75.0 m^3
	1.4.2074 - 31.3.2080.....	0 m^3
Total future arisings:		4106.0 m^3
Total waste volume:		4106.0 m^3

Comment on volumes: Future arisings are estimated and based on the programme to decommission facilities on-site. The decommissioning plans form part of the site liabilities plan that has been recently reviewed. The total volume of waste will depend on the longevity of the AWE site, which at present is based on a site closure date of 2080.

Uncertainty factors on volumes:

Stock (upper):	x	Arisings (upper)	x 5.0
Stock (lower):	x	Arisings (lower)	x 0.2

WASTE SOURCE Waste arising from enriched uranium decommissioning operations.

PHYSICAL CHARACTERISTICS

General description: The waste stream contain metal, rubble and plastics.

Physical components (%wt): The physical components of this waste stream are based on 7A112 (Decommissioning LLW DU/NU) waste stream disposals, as stock data for the 7A114 waste stream has not been generated before. This waste stream comprises of metal (43.74%), rubble (43.16%), NH plastic/plastic/rubber (6.73%), cellulosics (6.28%) and others (0.09%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m^3): ~0.51

Comment on density: This figure has been derived using the 7A112 disposal data as no stock currently exists (total stream mass divided by the total stream volume). Reviewed and revised in 2022. Similar to density figure quoted in the 2019 UKRWI.

CHEMICAL COMPOSITION

General description and components (%wt): Metal (43.74%), rubble (43.16%), NH plastics/plastic/rubber (6.73%), cellulosics (6.28%), graphite (0.02%) and asbestos (0.07%)

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Not present in Waste Stream
C-14: Not present in Waste Stream
Cl-36: Not present in Waste Stream
Se-79: Not present in Waste Stream
Tc-99: Not present in Waste Stream
I-129: Not present in Waste Stream
Ra: Only daughter products present from uranium in this waste stream. Oxide form
Th: Only daughter products present from uranium in this waste stream. Oxide form
U: Present in this waste stream. Oxide form
Np: Not present in Waste Stream
Pu: Not present in Waste Stream

WASTE STREAM 7A114 Decommissioning LLW - Enriched Uranium

Metals and alloys (%wt): The majority of decommissioning metal is sheets and pipes typically 4mm thickness.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	43.5		
Iron	0		
Aluminium	0		
Beryllium	0		
Cobalt	0		
Copper		See 'Other Metals'	
Lead	0		
Magnox/Magnesium	0		
Nickel	0		
Titanium	0		
Uranium	0		
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	0.23	Tin, brass and copper (unknown % weights)	

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	6.3		
Paper, cotton	0.21		
Wood	6.1		
Halogenated plastics	4.6		
Total non-halogenated plastics	1.9		
Condensation polymers	1.9		
Others	0		
Organic ion exchange materials	0		
Total rubber	0.27		
Halogenated rubber	0.27		
Non-halogenated rubber	0		
Hydrocarbons	0		
Oil or grease	0		
Fuel	0		
Asphalt/Tarmac (cont.coal tar)	0		
Asphalt/Tarmac (no coal tar)	0		
Bitumen	0		
Others	0		
Other organics	0		

Other materials (%wt): -

WASTE STREAM 7A114 Decommissioning LLW - Enriched Uranium

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	43.2		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	0.02		
Desiccants/Catalysts.....	0		
Asbestos.....	0.07	Form of asbestos is likely to be moderate / highly	
Non/low friable.....	NE	friable.	
Moderately friable.....	NE		
Highly friable.....	NE		
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
Fluoride.....	0	
Chloride.....	0	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	0	
Nitrate.....	0	
Nitrite.....	0	
Phosphate.....	0	
Sulphate.....	0	
Sulphide.....	0	

Materials of interest for waste acceptance criteria: This waste contains asbestos.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	P	
Putrescible wastes.....	0	
Non-putrescible wastes.....	P	Wood, paper and cotton

WASTE STREAM 7A114 Decommissioning LLW - Enriched Uranium

Corrosive materials	0
Pyrophoric materials	0
Generating toxic gases	0
Reacting with water	0
Higher activity particles	0
Soluble solids as bulk chemical compounds	0

Hazardous substances / non hazardous pollutants: This waste contains asbestos.

	(%wt)	Type(s) and comment
Acrylamide	0	
Benzene	NE	
Chlorinated solvents	0	
Formaldehyde	0	
Organometallics	0	
Phenol	NE	
Styrene	0	
Tri-butyl phosphate	NE	
Other organophosphates	0	
Vinyl chloride	P	
Arsenic	NE	
Barium	0	
Boron	NE	
Boron (in Boral)	NE	
Boron (non-Boral)		
Cadmium	NE	
Caesium	0	
Selenium	NE	
Chromium	NE	
Molybdenum	NE	
Thallium	0	
Tin	NE	
Vanadium	NE	
Mercury compounds	0	
Others	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1	0	
EEE Type 2	0	
EEE Type 3	0	
EEE Type 4	0	
EEE Type 5	0	

WASTE STREAM 7A114 Decommissioning LLW - Enriched Uranium

Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA.....	~0	
DPTA.....	~0	
NTA.....	~0	
Polycarboxylic acids…….	~0	
Other organic complexants.....	~0	Complexing agents are unlikely to be present in this Waste Stream as the waste has yet to be generated.
Total complexing agents.....	~0	

Potential for the waste to contain discrete items: Not yet determined.

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment	Off-site	43.7
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None	Off-site	56.3

Comment on planned treatments: Waste treatments have been estimated from Waste Stream 7A112 and 7A26. This Waste Stream will have quite a high fissile mass and wastes that cannot go to Permitted landfill will not meet the current WAC for supercompaction, so will be shipped to LLWR for repository burial.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~28.1	<0.51
Expected to be consigned to a Landfill Facility	~28.1	<0.51
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility		
Expected to be consigned to a Metal Treatment Facility	~43.7	>0.51
Expected to be consigned as Out of Scope		
Expected to be recycled / reused		
Disposal route not known		

Classification codes for waste expected to be consigned to a landfill facility: 170601, 170604, 170409, 170503, 170201, 170203, 170106, 170107

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

WASTE STREAM 7A114 Decommissioning LLW - Enriched Uranium

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known			

Opportunities for alternative disposal routing: Not yet determined

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m³	Number of packages
1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	28.1	17	68

Other information: It is assumed that the waste has not been supercompacted.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Decommissioning wastes can be loaded straight into a HHISO container, so voidage shall be avoided wherever practicable.

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste does not have a current WCH.

No requirement for a WCH until 2027.

Waste consigned for disposal to LLWR in year of generation: Yes.

Non-Containerised Waste for In-Vault Grouting: (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

Source: U-234, U-235, U-236 and U-238 contaminated material.

Uncertainty: It is diffcult to predict the likely specific activities for this waste stream as it has not been produced before. The activities have been decay corrected from the 2019 UKRWI 7A114 Waste Stream.

WASTE STREAM 7A114 Decommissioning LLW - Enriched Uranium

Definition of total alpha and total beta/gamma:	Where totals are shown on the table of radionuclide activities they are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'.
Measurement of radioactivities:	The fingerprints (varied enrichment) for these wastes are determined by the materials that have contaminated them. Both low and high resolution gamma-ray spectroscopy have been used as a method of assay.
Other information:	Decay nuclides with a half-life of less than 3 months have been omitted.

WASTE STREAM 7A114 Decommissioning LLW - Enriched Uranium

Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3					Gd 153				
Be 10					Ho 163				
C 14					Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55					Pb 210			2.54E-11	C C 2
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210			2.47E-11	C C 2
Zn 65					Ra 223			2.62E-10	C C 2
Se 79					Ra 225				
Kr 81					Ra 226			7.41E-11	C C 2
Kr 85					Ra 228			1.36E-16	C C 2
Rb 87					Ac 227			2.63E-10	C C 2
Sr 90					Th 227			2.59E-10	C C 2
Zr 93					Th 228			1.26E-16	C C 2
Nb 91					Th 229				
Nb 92					Th 230			7.48E-09	C C 2
Nb 93m					Th 232			1.66E-16	C C 2
Nb 94					Th 234			6.46E-08	C C 2
Mo 93					Pa 231			5.54E-10	C C 2
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234			1.77E-05	C C 2
Ag 108m					U 235			5.69E-07	C C 2
Ag 110m					U 236			7.32E-08	C C 2
Cd 109					U 238			6.46E-08	C C 2
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137					Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g				
Eu 154					**Total a**	**0**		**1.84E-05**	**C C 2**
Eu 155					**Total b/g**	**0**		**6.49E-08**	**C C 2**

Bands (Upper and Lower)

A a factor of 1.5
B a factor of 3
C a factor of 10
D a factor of 100
E a factor of 1000

Note: Bands quantify uncertainty in mean radioactivity.

Code

1 Measured activity
2 Derived activity (best estimate)
3 Derived activity (upper limit)
4 Not present
5 Present but not significant
6 Likely to be present but not assessed
7 Present in significant quantities but not determined
8 Not expected to be present in significant quantity